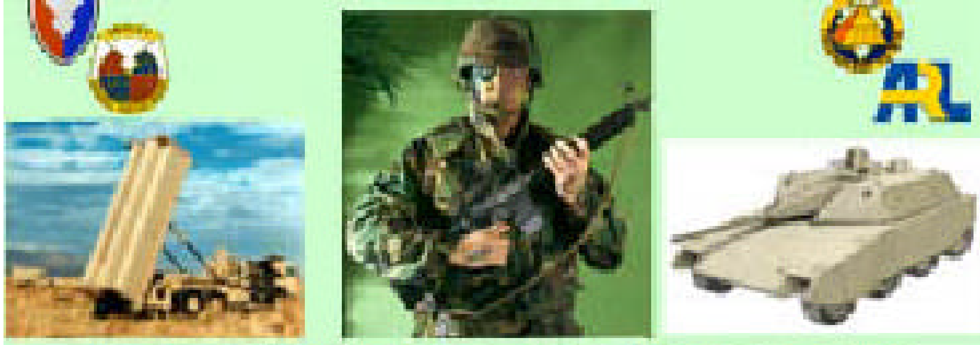

ARMY WEAPON SYSTEMS SURVIVABILITY

ARMY WEAPON SYSTEMS SURVIVABILITY

FOREWORD

In an address to the 45th Annual Meeting of the Association of the U.S. Army, 12 October 1999, Army Chief of Staff, General Eric K. Shinseki articulated his vision for the Army as soldiers on point for the nation transforming the most respected Army in the world, into a strategically responsive force that is dominant across the full spectrum of operations. His goal is to deliver a combat capable brigade anywhere in the world in 96 hours, a division on the ground in 120 hours, and five divisions in 30 days. General Shinseki envisions providing the agility and the versatility to transition rapidly from one point on that spectrum to another with the least loss of momentum. He has challenged the Army to find and prioritize solutions that optimize smaller, lighter, more lethal, yet more reliable, fuel-efficient, and more survivable options. To that end, the Army will seek the best combination of technologies that will provide survivability through low observable, ballistic protection, long-range acquisition, deep targeting, early attack, and first round kill at smaller caliber solutions.

The survivability functional areas described above contain tutorials on survivability considerations to assist Army combat developers and decision makers in making the hard decisions on system selections supporting the Army vision. They also describe the nature of survivability and lethality analysis and they contain information on how to obtain more detailed information that will assist in obtaining technical assistance in resolving survivability and lethality issues. We hope that you find these tutorials to be valuable and informative reference sources.

Comments and/or questions regarding this document should be directed to the Survivability/ Lethality Analysis Directorate, U. S. Army Research Laboratory, ATTN: Mr. Connie Hopper, White Sands Missile Range (WSMR) 88002-5513. Telephone: DSN 258-7952 or Commercial (505) 678-7952.

SECTION I
SYSTEM SURVIVABILITY AS PART OF THE ARMY VISION

A DIFFERENT KIND OF ARMY IN A DIFFERENT AND DANGEROUS WORLD

The world environment has changed fundamentally from the former bipolar environment of the Cold War. “The world remains a dangerous place full of authoritarian regimes and criminal interests whose combined influence extend the envelope of human suffering by creating haves and have-nots. They foster an environment for extremism and the drive to acquire asymmetric capabilities and weapons of mass destruction. They also fuel an irrepressible human demand for freedom and a greater sharing of the better life. The threats to peace and stability are numerous, complex, oftentimes linked, and sometimes aggravated by natural disaster. The spectrum of likely operations describes a need for land forces in joint, combined, and multinational formations for a variety of missions extending from humanitarian assistance and disaster relief to peacekeeping and peacemaking to major theater wars, including conflicts involving the potential use of weapons of mass destruction. The Army will be responsive and dominant at every point on that spectrum. We will provide to the Nation an array of deployable, agile, versatile, lethal, survivable, and sustainable formations, which are affordable and capable of reversing the conditions of human suffering rapidly and resolving conflicts decisively. The Army's deployment is the surest sign of America's commitment to accomplishing any mission that occurs on land."[1]

Today, and in the foreseeable future, the spectrum of likely military operations ranges from sustaining and support operations (SASO) to small-scale contingencies (SSC) to major theater war (MTW) as shown in Figure I-1**.** The Army plans to develop the capability to be strategically responsive and capable in meeting requirements for small-scale contingencies without compromising our MTW capability. The objective force is a rapidly deployable combat brigade that:

-in small-scale contingencies, is capable of determining the outcome;

-in stability and support operations, is the guarantor combat force, and

-in MTW, can fight as part of the Division.

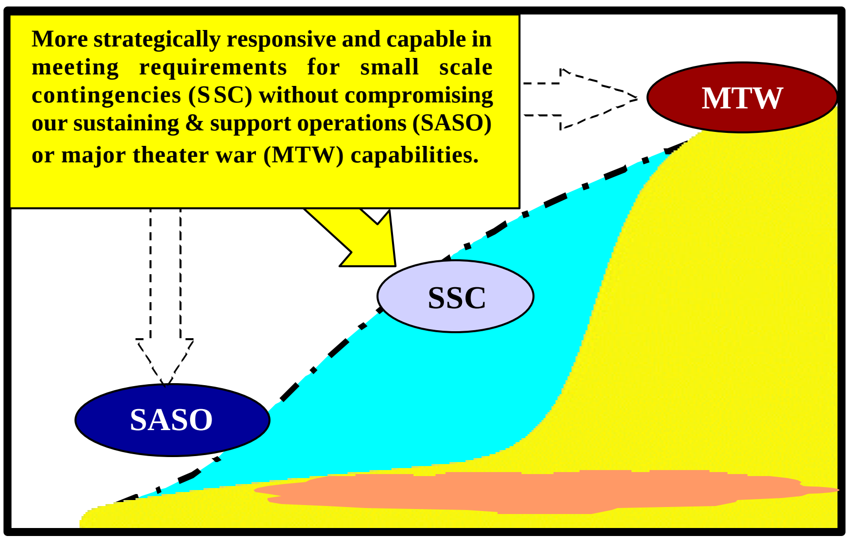

Figure I-1. Full Spectrum Force - Strategically Responsive and Dominant.

As witnessed in Somalia, some missions may begin benignly, but can suddenly become highly dangerous for our soldiers due to inherent uncertainties and/or restrictive rules of engagement. In some scenarios, our soldiers may not have the authority or capability to fire first.

Their lives may depend solely on the level of protection our technology provides. It does not matter what the current intentions of the countries are. If we have learned any lesson from history, it is our inability to accurately predict the current or future intentions of most nations. Any country that might become our adversary next year or 10 years from now can acquire world-class, highly effective weapons on the global market. The U.S. Army must possess the ability to deploy capable and survivable military forces that can accomplish the broad variety of tasks they may be assigned. System survivability must encompass threats that run the gamut from the crude to the sophisticated—from homemade booby traps to remotely launched "smart" missiles.

Over the next decade, there is every indication that weapons and weapons technology will proliferate at an even greater pace. During the Cold War, both the North Atlantic Treaty Organization (NATO) and the Warsaw Pact made some efforts to keep sensitive weapons

[1] Army Vision Statement, 12 October 1999.

technologies from falling into the hands of the other side or third parties. With the reduction of tensions between NATO and Eastern Europe countries, and the dissolution of the Warsaw Pact, less restricted and more vigorous international arms sales may permit countries with regional aspirations to acquire very sophisticated, highly lethal weapons. The effectiveness of sophisticated American weapons during the Gulf War is a lesson not lost on the countries of the world. Among the capabilities they hope to possess are smart weapons and munitions that markedly improve the weapons' accuracy, as well as allow them to be fired from greater distances. Another emerging threat will be improved reconnaissance and surveillance. These countries understand that one of the keys to increased lethality in modern warfare is early target acquisition. Also, the great advantage U.S. forces currently possess during periods of limited visibility may be challenged. Forward-looking infrared (FLIR) technology of increasing sophistication is available on the world's markets. Other significant threats are the possible employment of weapons of mass destruction, information warfare, terrorism, or other asymmetric means against our forces. We can depend on our future adversaries to use their most effective weapons against our most vulnerable points.

The survivability and lethality of materiel and soldiers is a critical part of mission accomplishment, whether the mission is peacekeeping or war. Department of Defense (DOD) Regulation 5000.2, "Mandatory Procedures for Major Defense Acquisition Programs (MDAPs) and Major Automated Information System (MAIS) Acquisition Programs," and Army Regulation 70-75 "Survivability of Army Personnel and Materiel" require that survivability of Army systems be addressed throughout the acquisition process. These laws and regulations notwithstanding, public expectations, heightened by the blow-by-blow media coverage during Operation Desert Storm, and the Army's own expectations for decisive battles, low casualties, and low collateral damage have brought increased emphasis on how the Army addresses system survivability, lethality, and vulnerability.

THE SURVIVABILITY CHALLENGE

"We will derive the technology that provides maximum protection to our forces at the individual soldier level whether that soldier is dismounted or mounted."[1] The goals of increased agility and deployability will require technological solutions that optimize system size, weight, lethality, and survivability. Survivability solutions will require the best combination of technologies that will provide low observable, ballistic protection, long-range acquisition, deep targeting, early attack, and first round kill at smaller caliber solutions. As an example, the use of anything to increase system survivability may be constrained in terms of adding to system weight. This is particularly true for ballistic armor, but even more advanced approaches to protection, such as reactive armor, active protection systems, or even electronic protection measures, may impose some additional weight requirements on the system design. These can be both direct and indirect (e.g., increased electrical power requirements for defensive measures could mean bigger, heavier power-generation and/or storage subsystems). Increased armor could require heavier automotive and suspension systems).

By itself, the necessity to minimize friendly casualties and preserve mission essential equipment in the face of increased threats and hostile environments is a difficult challenge. But to do so, while reducing the weight of system designs and in a less than robust funding environment, is especially challenging.

WHAT DOES IT TAKE TO BE SURVIVABLE?

There are many things the Army does that contribute to the survivability of its forces, weapons systems, equipment, and soldiers. Almost all efforts done well in the areas of doctrine, training, leader development, organization, materiel, and soldiers (DTLOMS) will have an impact on survivability. The soundness of our doctrine, realism of our training, competence of our leaders, the equipage and mix of our forces, and the intelligence and toughness of our soldiers all contribute to minimizing friendly losses. In a somewhat more specific sense, the following capabilities all affect the survivability of U.S. forces, systems, equipment, and soldiers: strategy; mobility; tactics, techniques, and procedures (TTP); information dominance and situational awareness; operating inside the enemy's decision loop; concealment and deception; dispersion of forces; and equipment reconstitution. And, of course, damaging and destroying enemy forces before they can strike, particularly without revealing friendly forces' locations and dispositions, have a significant effect on the survivability of friendly forces.

Notwithstanding the valuable contributions of all these elements, having inherently survivable weapons systems, equipment, and soldiers is still very important to the survivability of U.S. forces. The focus of this document is the issue of survivability at the system level. Opportunities to ensure the adequacy of the survivability of new weapons systems and enhance the survivability of existing ones will occur as the Army continues to modernize.

SURVIVABILITY DEFINITIONS

Survivability is defined as "The capability of a system and crew to avoid or withstand a man-made hostile environment without suffering an abortive impairment of its ability to accomplish its designated mission."[2] The roles and responsibilities for soldier survivability are defined in Army regulations. These regulations define soldier survivability in "system" and "soldier" terms as follows:

System. The characteristics of a system that can reduce fratricide, as well as reduce detectability of the soldier, prevent attack if detected, prevent damage if attacked, minimize medical injury if wounded or otherwise injured, and reduce physical and mental fatigue.[3]

Soldier. Those characteristics of soldiers that enable them to withstand (or avoid) adverse military action or the effects of natural phenomena that would result in the loss of capability to continue effective performance of the prescribed mission.[3]

The key words in the survivability definition in DoD 5000.2-R are "to avoid or withstand." These are measures of a system's <u>susceptibility</u> and <u>vulnerability</u> to the hostile environment.

Susceptibility is defined as "the degree to which a weapon system is open to effective attack

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[2] U.S. Department of Defense Regulation, *Mandatory Procedures for Major Defense Acquisition Programs (MDAP) and Major Automated Information System (MAIS) Acquisition Programs (DOD 5000.2-R*), Washington, DC, 1 January 2001.

[3] U.S. Department of the Army. Manpower and Personnel Integration (MANPRINT) in the System Acquisition Process, AR 602-2, Washington, DC, 10 January 1995.

due to one or more inherent weakness. (Susceptibility is a function of operational tactics, counter-measures, probability of enemy fielding a threat, etc.). Susceptibility is considered a subset of survivability."[2] Susceptibility can be divided into three general categories of threat activity: (a) detecting, identifying, acquiring, and tracking; (b) launch or firing; and (c) munitions impact or detonation. Susceptibility of a weapon system is influenced by such features as the system design (e.g., signature and maneuverability), tactics used (e.g., terrain masking to avoid detection), and survivability equipment and weapons it carries (e.g., electronic countermeasures).

Vulnerability is defined as "the characteristic of a system that causes it to suffer a definite degradation (loss or reduction of capability to perform its designated mission) as a result of having been subjected to a certain (defined) level of effects in an unnatural (man-made) hostile environment. Vulnerability is considered a subset of survivability."[2] Vulnerability is determined by the system's design and any features that reduce the amount and effects of damage when the system takes one or more hits.

SURVIVABILITY AS THREAT AVOIDANCE

Survivability is based primarily on avoidance, as shown in Figure I-2 (i.e., avoid being detected; if detected, avoid being acquired as a target; if acquired as a target, avoid being hit; if hit, avoid being damaged; if damaged, avoid being killed).

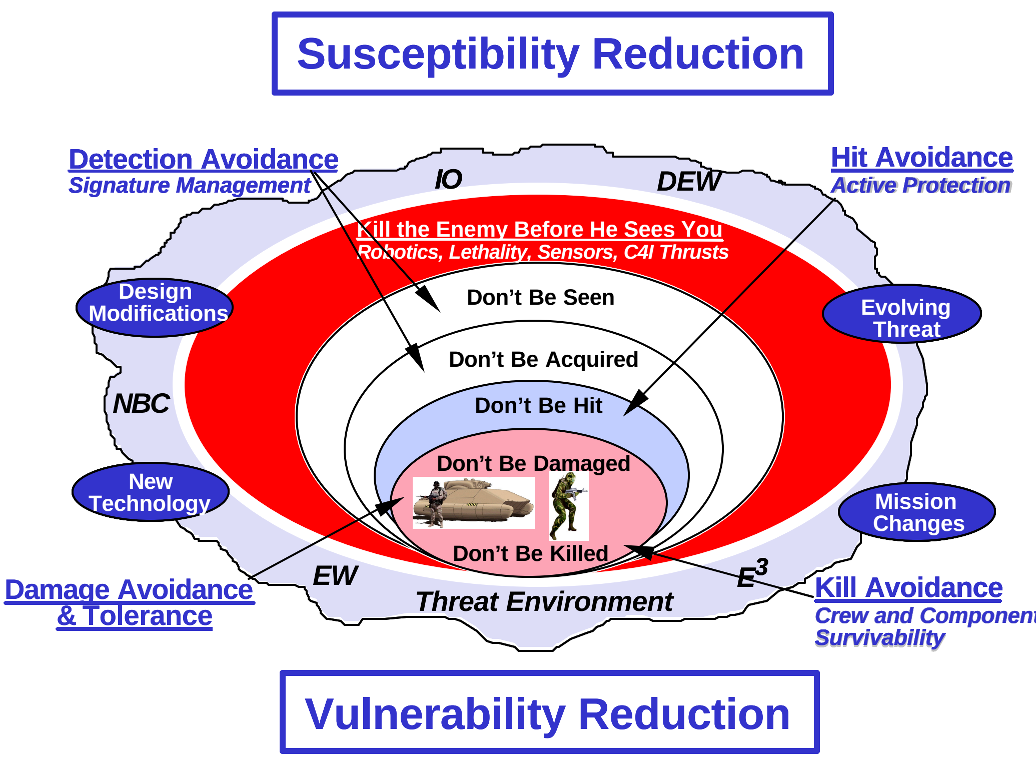

Figure I-2. Threat Avoidance Categories.

Detection Avoidance. Detection avoidance includes all the technologies and methods used to suppress the sights, sounds, and images normally associated with aircraft. Making systems harder to find makes them harder to kill while substantially increasing their lethality. Great gains in survivability and lethality are achieved due to detection avoidance technologies, but these technologies are also normally the highest in cost to develop, integrate, and maintain.

Hit Avoidance. Hit avoidance refers to technologies that allow a system to avoid being hit by a weapon after it has been detected by the enemy. Hit avoidance includes avoidance of both acquisition and tracking by enemy fire control, and interception by enemy weapons. Most hit avoidance technologies are not stand-alone; they are integrated into systems that deflect, disorient, or defeat the threat.

Damage Avoidance and Tolerance. After being detected and hit, a system may be unable to prevent penetration. It may instead rely on damage avoidance. Damage avoidance may be accomplished through the use of ballistic shielding, electronic and nuclear, biological, and chemical (NBC) filters, overpressure, redundancy and hardening of critical subsystems.

Kill Avoidance. Kill avoidance technologies permit a system and its personnel to live and fight another day after being detected, hit and damaged. These technologies include NBC protection systems, ammunition and fuel compartmentation, fire suppression, spall and nuclear shielding, optics and electronics hardening, ballistic shock protection, critical component redundancy, component separation, and shielding of critical components with less critical components.

Mathematically, the probability (P) of survival can be expressed as follows:

P(Survivability) = 1 - {P(Detection) • P(Acquisition given Detection) • P(Hit given Acquisition) • P(Damage given Hit) • P(Kill given Damage)}.

This set of conditions has been fundamentally true since the beginning of warfare. What has changed over time is the probability of occurrence of each of the elements in a given set of circumstances. If any element of survivability (avoidance of detection, acquisition, hit, penetration, and kill) can be improved, then the overall probability of survival is increased.

SOLDIER SURVIVABILITY CHARACTERISTICS

The individual soldier continues to be the focus of the close fight. Soldiers as land and aircrew members are also central to the effective performance of all manned weapon systems. Dramatic improvements in war-fighting capabilities will occur by improving/enhancing soldier survivability in two primary ways: (1) by designing a better soldier system for land and air operations and (2) by ensuring all weapon systems incorporate systems design characteristics to enhance soldier survivability. Soldier survivability characteristics are those which:

SURVIVABILITY ANALYSIS

It is possible to reduce a weapon system’s vulnerability to one or more specific threats but inadvertently increase the vulnerability to one or more other threats. Thus, it is essential that the effects of all threats on a system be examined in an integrated manner. It is also essential that survivability enhancement recommendations be analyzed and tested for effectiveness of their intended purpose and their compatibility with other applications. The Army’s system survivability, lethality, and vulnerability (SLV) analysis process is a comprehensive, integrated process that determines if the plan for a new system, a modification to an existing system, or an Equipment Change Proposal (ECP) enhances survivability or reduces vulnerability or susceptibility. The Army’s principal organization for performing this type of analysis is the

Army Research Laboratory's Survivability/Lethality Analysis Directorate (ARL SLAD). More detailed information on this organization, its capabilities, and how to contact them are presented in Section II.

The survivability of a component, subsystem, or the entire system may change during the various phases of the system's life cycle. Some of these changes are a result of changes in the design, changes in the manufacturing techniques, or changes in the final materials. For example, the adverse effect of a long rod penetrator against an armored vehicle might be lessened with the addition of a particular spall liner. Doing this may lead to the assumption that the survivability of the armored vehicle has been improved. If, however, it turns out that the spall liner material emits a toxic substance or easily results in a catastrophic fire when penetrated by a shaped charge jet, the survivability of the armored vehicle may have been increased in one respect (i.e., long rod penetration) while inadvertently decreased in other respects. A properly conducted integrated survivability analysis would reveal the dilemma so that corrective action could be taken before an original enhancement was implemented. While a proposed survivability enhancement may appear very promising in theory, it is essential that qualified scientists and engineers perform a rigorous survivability analysis so that the overall survivability of the system can be determined based on the best information available. The process of performing a comprehensive SLV analysis is complex, detailed, and can extend over a period of many years. An overview of a general SLV analysis, with some of the steps and parameters that must be considered, is presented in Section II.

REDUCING RISK EARLY

While the importance of survivability throughout system development is generally recognized and accepted, in reality, survivability efforts are as much or even more beneficial when applied prior to the establishment of a "formal" system. The overall cost of a system is significantly reduced when survivability is "built-in" rather than "added-on," as indicated in Figure I-4. Considerable impact on the survivability of an eventual system can and should be effected during science and technology (S&T) developments, concept studies, and warfighting experimentation. A major Army initiative that can have a significant impact on survivability (as well as RDA) is the early insertion of the Army warfighting experiments (AWEs) for advanced technology demonstrations (ATDs) and advanced concept technology demonstrations (ACTDs), if survivability considerations are part of the AWE. Because 90% of RDA costs can be influenced by decisions made before Milestone II, it is imperative that we make the right decisions early. Risk reduction during the later phases (e.g., EMD) is much more expensive. Reducing risk early can be accomplished through various methods to include the aforementioned AWEs, ATDs, and ACTDs, as well as a greater use of modeling and simulation (M&S). M&S can include live simulations and field trials, constructive simulations, and distributed virtual simulations. The live simulations and field trials use "real soldiers" and "real units" in a tactically competitive environment. The constructive simulations and distributed virtual simulations can replicate the combined arms battlefield with increasing fidelity. The results of these simulations serve to speed up the development cycle by better determining the benefits and shortcomings of a system before the commitment of greater resources.

For the full benefit of survivability efforts to be realized, they must be aggressively pursued not only during system development, but also early in the considerations for any P3I program, system modifications such as ECPs, or purchases of COTS. It is essential that survivability be considered throughout the acquisition cycle.

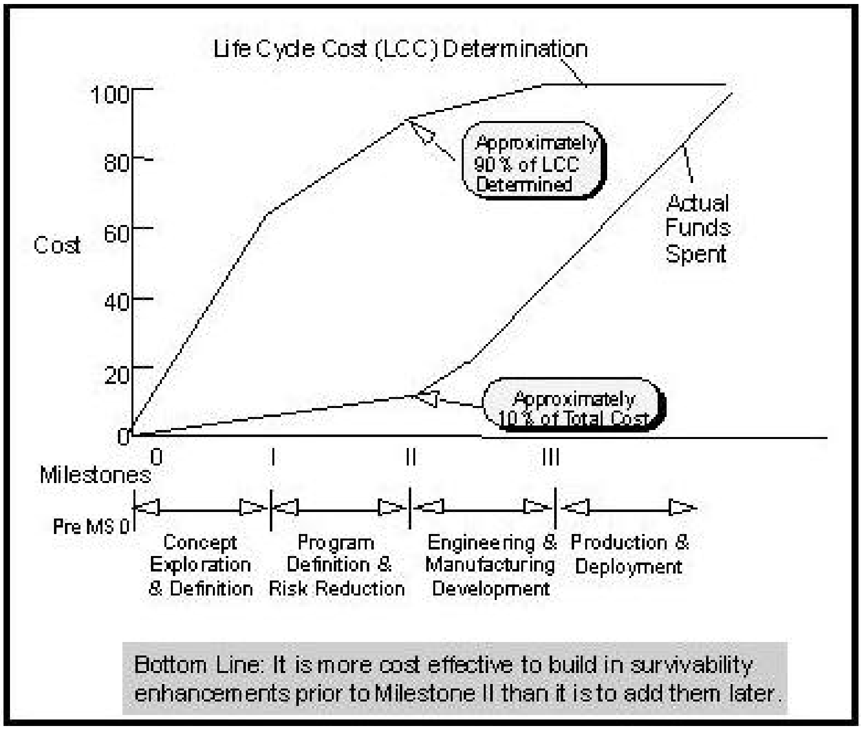

Figure I-4. Life-Cycle Cost.

Reduce Detectability of the Soldier. Prevent the visual, acoustic, electromagnetic, infrared/ thermal, radar detection by the enemy of individual soldiers, mounted or dismounted. Detectability reduction could include the use of low-observable technology, smoke, training, and doctrine.

Prevent Attack on the Soldier, if Detected. Methods of preventing attack include using decoys and warning sensors for ballistic and NBC attacks and employing maximum effective ranges of friendly weapons outside the enemy's maximum effective range.

Prevent Bodily Damage, if Attacked. This component includes protecting the soldier from traditional insults such as bullets, shrapnel, blast, and thermal; and preventing damage from chemical agents, biological agents, nuclear, and laser, high-powered microwave and acoustic systems. Further, the soldier should be protected from natural phenomena such as temperature extremes or deep water. Measures for preventing bodily damage include armored compartments for mounted soldiers, fire suppression systems, ballistic protection jackets, nonflammable fabrics, chemical protection clothing, visors with tunable laser protection, and cold weather clothing.

Minimize Medical Injury, if Wounded. If a soldier is wounded, efforts must be made to prevent fatality or physical disabilities and evacuate the soldier quickly and efficiently to medical treatment facilities. Casualty reduction measures include first-aid packets, bodily function sensors connected to a vehicle, or personal computer/communications system, antidotes, trauma treatment at the squad/crew level, and escape hatches.

Reduce Fratricide. Reduce the unforeseen and unintentional death or injury of personnel resulting from the employment of friendly weapons and munitions. Soldier and other weapons systems should be designed with improved antifratricide systems such as identification of friend or foe (IFF) and situational awareness systems.

Reduce Physical and Mental Fatigue. Soldiers must receive proper sustenance and be equipped with the clothing and equipment that maintain physical capabilities and enhance mental alertness. In addition, vehicle, aircraft, and soldier systems must not increase physical stress on the soldier. Relevant measures include lightweight protective clothing, highly nutritious rations, on-board hygiene systems, reduced noise levels, crew comfort, chemical protective suits that breathe, and other efforts to reduce anxiety in combat (e.g., decision aid systems and sensor technologies that provide opportunities to sleep).

MAKING MAXIMUM USE OF INVESTMENTS

The Army must make full use of its previous investments by maintaining equipment currently in the force. This means that every effort must be made to improve capabilities through preplanned product improvements and other upgrade programs before acquiring new systems. In any case, survivability enhancements do not have to wait until the next generation of systems is fielded. Every effort should be made to develop solutions that can be applied with the least degradation of the Army's mission requirements and at the lowest cost.

LIVE-FIRE TESTING

Federal law and DoD regulations provide specific live-fire testing requirements during the acquisition process. Federal law[4] requires that a covered system may not proceed beyond low-rate initial production until realistic survivability testing of the system is completed.

The term "realistic survivability testing" means, in the case of a covered system (or a covered product improvement program for a covered system), testing for vulnerability of the system in combat by firing munitions likely to be encountered in combat (or munitions with a capability similar to such munitions) at the system configured for combat, with the primary emphasis on testing vulnerability with respect to potential user casualties, and, taking into equal consideration, the susceptibility to attack and combat performance of the system. The term configured for combat refers to a weapon system, platform, or vehicle loaded or equipped with all dangerous materials (including all flammable and explosives) that would normally be on board in combat. Waivers or alternative testing may be approved under certain conditions as prescribed in DoD 5000.2-R. However, a waiver of requirements for realistic survivability testing does not eliminate the need for survivability testing of components, subsystems, and subassemblies.

The first system to undergo live-fire testing was the Bradley Fighting Vehicle System (BFVS) in 1987. The BFVS had 150 offline tests and 123 full-up live-fire shots. The Army learned much from these live-fire tests. In particular, the contribution of the behind armor debris phenomenon in causing casualties and damage to systems and equipment in the vehicle interior was revealed. This led to the development of spall liners for the BFVS and also the M113 armored personnel carrier families of vehicles, which significantly improved the overall survivability of these systems. The Army test, evaluation, and analysis communities have become very adept at

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4 U.S. Code. *Major Systems and Munitions Programs: Survivability Testing and Lethality Testing Before Full-Scale Production,* Title 10, Section 2366, Washington, DC.

maximizing the information gained from live-fire testing while reducing the number and cost of these tests. Over time, greater confidence has been developed in computer simulations and modeling of the various mechanisms of attack (lethality). Currently, the emphasis is on component/subsystem and nondestructive testing to reduce the number of very expensive full-up live-fire tests.

SURVIVABILITY IMPROVEMENT LATER IN THE LIFE CYCLE

Most major Army weapons systems tend to have very long life cycles. It is not uncommon for them to last for several decades. Several factors can contribute to this longevity, such as cost and robustness of the original design. The M551 Sheridan saw three decades of active duty service, despite less than universal satisfaction with its performance and, in particular, its survivability characteristics. The M113 family of vehicles (FOV) is still in service after more than four decades since its initial fielding. Today's M113 FOV is an example of how the survivability of a major system can improve over time. The original version of the M113 was gasoline fueled and was subject to catastrophic loss from fuel tank explosions. Conversion to a diesel engine was a considerable improvement. Extensive survivability analysis and live-fire testing led to the introduction of spall liners and external armored fuel cells, further improving the system's survivability. Even greater survivability enhancement was achieved with the development of armor tiles for the M113.

The survivability of major weapons systems with respect to evolving threats must be periodically analyzed and reviewed in order to determine when survivability upgrades should be undertaken and what form they should take. Preplanned product improvements (P3I) and block improvement programs are two means. Other opportunities for improving survivability will occur during recapitalization events, such as extended service programs, depot overhauls, and deliberate technology insertion. Development and exploitation of the most promising survivability technologies with a view toward horizontal insertion across multiple platforms and designing with the necessity for changing and/or improving the system's survivability throughout its life cycle offer the opportunity to mitigate the expense while still improving survivability.

TRENDS IN SURVIVABILITY

The current emphasis on mobility and deployability is driving a search for more efficient protection, particularly from ballistic threats. In this case, efficiency relates to the mass (weight) or volume of armor, or component redundancy, required to provide a given level of protection. As the Army transitions to a rapidly deployable combat brigade as part of a full-spectrum force, a number of approaches and platforms will be investigated. These approaches will likely range from the application of more efficient materials, such as titanium or composites, to explosive reactive armor. Nontraditional approaches, such as electronic warfare and active protection, where threats are deflected while they are still inbound, are also under investigation.

While there does not appear to be a likely peer threat to emerge in the near- to mid-term, U.S. systems are likely to be attacked at their most vulnerable points by an adversary's best weapons. Asymmetric threats are an increasing area of concern. Therefore, increased emphasis on dealing with such threats as weapons of mass destruction and, in particular, biological and chemical threats is appropriate. As a matter of both efficiency and cost effectiveness, U.S. defenses against nuclear, biological, and chemical (NBC) threats will, for the most part, be dealt with in the joint arena in the future. There are many potential improvements in the technology base, but NBC defense will remain a very challenging area for the foreseeable future.

Information dominance presents both opportunities and new susceptibilities and vulnerabilities. The U.S. Army's digitization effort entails equipping the warfighter with a digital data generation and processing capability and access to a seamless digital data communications network. This effort entails eliminating existing information stovepipes by integrating, both horizontally and vertically, those communications and information systems that support the warfighter. While this is how to get to information dominance, it also presents new susceptibilities and potential vulnerabilities. Where before an attack on an individual combat vehicle presented a threat only to that system, in the digitized force, an information attack on any vehicle in the network may pose a threat to an entire network, with the vehicle serving as a network entry point. Also, the reliance on commercial off-the-shelf (COTS) hardware and software in the digitization effort presents challenges to the security of the digitized force. Reliance on COTS technologies increases the likelihood that adversaries and potential adversaries will have access to information technologies similar to those the U.S. possesses. Faced with so many potential forms of attack and means of access to the Army Tactical Internet, a new approach to survivability may be required. This may be based on networks that are resilient and adaptive rather than undetectable or unassailable.

CONCLUSION

The Army has begun to transition into a force that will satisfy current needs to be more strategically responsive and dominant in meeting requirements for small scale contingencies without compromising its major theater war capability. To achieve this goal, the Army will develop a capability, using available systems and technical insertions, to provide an interim solution. The brigade combat team (BCT) optimizes the tenets of this operational concept and organizational design by achieving the most effective balance of force projection and battlespace dominance, as shown in Figure I-5.* Investments will be in today's off-the-shelf technology to stimulate the development of doctrine, organizational design, and leader training even as the search begins for new technologies for the objective force.

One key to achieving this vision is survivability. The Army intends will derive the technology that provides maximum protection to its forces at the individual soldier level whether, that soldier is dismounted or mounted. The combined goals are to dominate the expanded battlespace, and at the same time, protect the force.

Survivability analysis plays an important role in this vision. At the system level, it provides combat developers with an understanding of the impact various requirements have on a design's survivability. For materiel developers, it assists in making the cost/effectiveness tradeoffs to achieve the system's requirements. Later in a system's life, survivability analysis provides the data needed to assess the impact of changes in threat and what can or must be done about them. The ultimate value of survivability analysis is to quantify information for leaders and decision makers so that risks to soldiers and weapon systems can be understood and decisions can be made effectively.

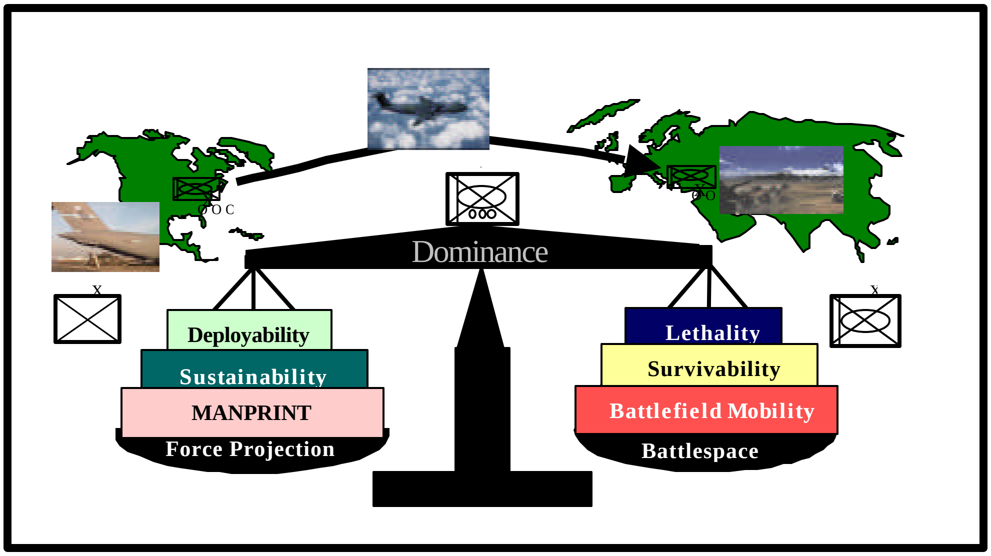

Figure I-5. Achieving Force Effectiveness.

***Extracted from briefing titled "The Army Vision – A TRADOC Perspective" Brigade Industry Day, 1 Dec 99.**

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